

Laryngeal typology of endangered Indo-Iranian, Sino-Tibetan, and Isolate languages

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The Indo-Iranian, Sino-Tibetan, and Isolate languages of Northern Pakistan are characterized by 2-, 3-, and 4-way laryngeal contrasts at four or five places of articulation (Hussain, 2018). It is generally believed that voiced stops are characterized by advanced tongue root (Ahn, 2018; Hussain & Mielke, in press), which could be used as a voicing enhancement strategy. Voiced stops are also known to lower the f_0 of the following vowel onsets (Hombert et al., 1979). The current study investigates the acoustic and articulatory correlates (tongue root advancement and pitch (f_0)) of rich stop laryngeal contrasts of six endangered languages of Northern Pakistan (Balti: Sino-Tibetan; Burushaski: Isolate; Kalasha, Khovar, and Shina: Dardic, Indo-Aryan; Wakhi: Iranian).

The acoustic and articulatory data were collected from 24 participants in Chitral and Gilgit, Northern Pakistan (Balti: 4; Burushaski: 4; Kalasha: 4; Khovar: 4; Shina: 5; Wakhi: 3). A word list of nonsense word-initial stops varying in 2- to 4-way laryngeal contrasts was created (e.g., /pa/, /p^ha/, /ba/, /b^ha/). A Terason t3000 ultrasound machine with Ultraspeech 1.3 software was used for recording the ultrasound data (60 fps). An Articulate Instruments headset was used for ultrasound probe stabilization. Simultaneous audio recordings were made with a Shure Beta 53 head-mounted condenser microphone (44.1 kHz, 16-bit). Ultrasound data were recorded for coronals and velars and acoustic for all stops. Each target word was repeated five times. Pitch (f_0) onsets of the vowels following stops, and tongue contours 10 ms before the release of the stops, were measured.

Figure 1 indicates that the tongue root is predominantly advanced in voiced stops for most of the languages and speakers, consistent with Ahn's (2018) findings for English and Brazilian Portuguese. However, Khovar appears to be an exception to this pattern: most of the Khovar speakers produced voiced unaspirated *and voiceless unaspirated* with more advanced tongue root than voiceless aspirated stops. Figure 2 presents pitch (f_0) onsets across languages. Voiced stops are consistently characterized by low pitch onsets for Balti, Burushaski, Shina, and Wakhi speakers, consistent with the pattern observed by Hombert et al. (1979). However, some Kalasha and Khovar speakers show higher pitch onsets which overlap with the voiceless stops.

Elevated f_0 after voiceless unaspirated consonants in Kalasha (relative to the other stop laryngeal categories) is contrary to the hierarchy of consonantal f_0 effects suggested by Hyman & Schuh (1974), where voiceless aspirated consonants have a greater raising effect than voiceless unaspirated consonants. In West African languages, f_0 lowering effects are typically centered on voiced consonants (Hyman & Schuh, 1974; Bradshaw, 1999), but the f_0 effects we have seen here do not distinguish voiced consonants from voiceless aspirated consonants of Kalasha. However, we note that most African languages are predominantly non-aspirating (Maddieson, 1984), and that CiTonga, a Bantu language of Malawi has depressor consonants consisting of voiced obstruents, aspirated stops, but not plain voiceless obstruents, prenasalized voiced stops, or sonorants (Bickmore & Mkochi, 2019).

The findings of this study also indicate that some languages and their speakers do not follow the expected dominant patterns of tongue root advancement and pitch. Historically, all the Indo-Iranian (Indo-Aryan, Iranian, and Nuristani) languages contrasted voiced aspirated consonants which either merged with the plain voiced or voiceless consonants in Khovar, Shina, and Wakhi. Our findings raise interesting questions regarding the acoustic and articulatory correlates and the development or loss of laryngeal contrasts in endangered and typologically distinct languages.

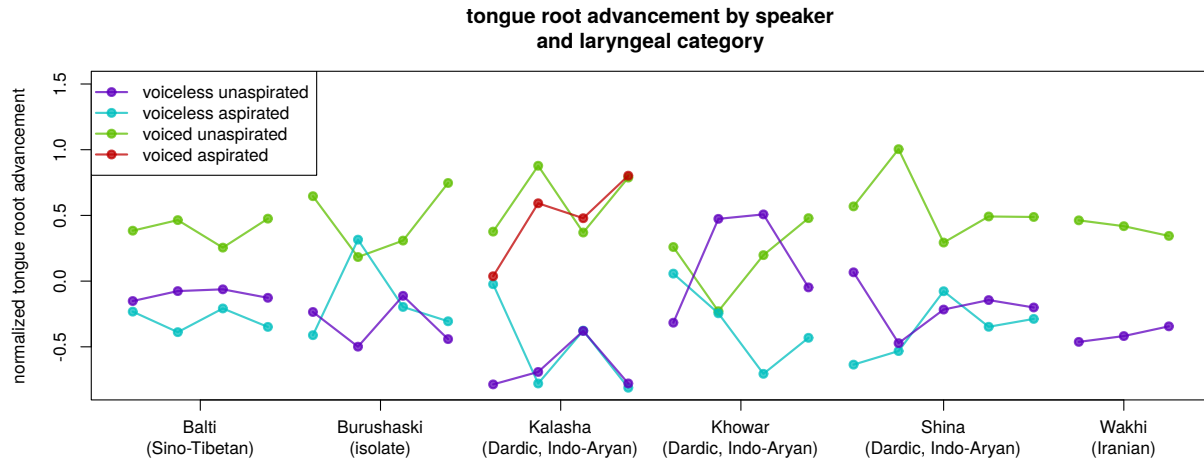


Figure 1: Normalized tongue root advancement by speaker (circles), language, and laryngeal category (collapsed across place of articulation).

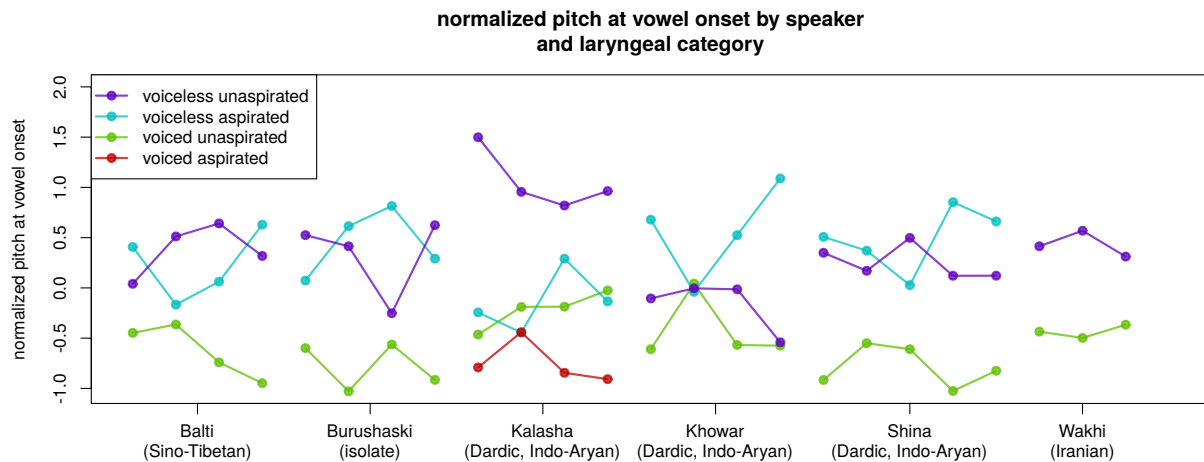


Figure 2: Normalized pitch (f0) by speaker (circles), language, and laryngeal category (collapsed across place of articulation).

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